Designation: B581 – 17 (Reapproved 2023)

Standard Specification for Nickel-Chromium-Iron-Molybdenum-Copper Alloy Rod[1]

This standard is issued under the fixed designation B581; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This specification[2] covers rod of Ni-Cr-Fe-Mo-Cu alloys (UNS N06007, N06975, N06985, N06030, N08031, and N08034)[3] as shown in Tables 1-3, for use in general corrosive service.

1.2 The following products are covered under this specification:

1.2.1 Rods 5⁄16 in. to ¾ in. (7.94 mm to 19.05 mm) excl in diameter, hot- or cold-finished, solution annealed and pickled or mechanically descaled.

1.2.2 Rods ¾ in. to 3½ in. (19.05 mm to 88.9 mm) incl in diameter, hot- or cold-finished, solution annealed, ground or turned.

1.3 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[4]

B880 Specification for General Requirements for Chemical Check Analysis Limits for Nickel, Nickel Alloys and Cobalt Alloys

E8 Test Methods for Tension Testing of Metallic Materials [Metric] E0008_E0008M

E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

E55 Practice for Sampling Wrought Nonferrous Metals and Alloys for Determination of Chemical Composition

E1473 Test Methods for Chemical Analysis of Nickel, Cobalt, and High-Temperature Alloys

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *rod, n*—material of round solid section furnished in straight lengths.

4. Ordering Information

4.1 It is the responsibility of the purchaser to specify all requirements that are necessary for material ordered under this specification. Examples of such requirements include, but are not limited to the following:

4.1.1 *Alloy*—Table 1.

4.1.2 *Dimensions*—Nominal diameter and length. The shortest useable multiple length shall be specified (Table 4).

4.1.3 *Certification*—State if certification or a report of test results is required (Section 16).

4.1.4 *Purchaser Inspection*—State which tests or inspections are to be witnessed (Section 14).

4.1.5 *Samples for Product (Check) Analysis*—State whether samples shall be furnished (10.2.2).

5. Chemical Composition

5.1 *Heat Analysis*—The material shall conform to the composition limits specified in Table 1.

[1] This specification is under the jurisdiction of ASTM Committee B02 on Nonferrous Metals and Alloys and is the direct responsibility of Subcommittee B02.07 on Refined Nickel and Cobalt and Their Alloys.

Current edition approved April 1, 2023. Published May 2023. Originally approved in 1973. Last previous edition approved in 2017 as B581 – 17. DOI: 10.1520/B0581-17R23.

[2] For ASME Boiler and Pressure Vessel Code applications see related Specification SB-581 in Section II of that Code.

[3] New designation established in accordance with ASTM E527 and SAE J1086, Practice for Numbering Metals and Alloys (UNS).

[4] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

TABLE 1 Chemical Requirements

Element	Composition Limits, %					
	Alloy N06007	Alloy N06975	Alloy N06985	Alloy N06030	Alloy N08031	Alloy N08034
Nickel	remainder[A]	47.0–52.0	remainder[A]	remainder[A]	30.0-32.0	33.5-35.0
Chromium	21.0–23.5	23.0–26.0	21.0–23.5	28.0–31.5	26.0-28.0	26.0-27.0
Iron	18.0–21.0	remainder[A]	18.0–21.0	13.0–17.0	remainder[A]	remainder[A]
Molybdenum	5.5–7.5	5.0–7.0	6.0–8.0	4.0–6.0	6.0-7.0	6.0-7.0
Copper	1.5–2.5	0.70–1.20	1.5–2.5	1.0–2.4	1.0-1.4	0.5-1.5
Manganese	1.0–2.0	1.0 max	1.0 max	1.5 max	2.0 max	1.0-4.0
Cobalt, max	2.5	...	5.0 max	5.0 max	...	...
Carbon, max	0.05	0.03	0.015 max	0.03 max	0.015	0.01
Tungsten	1.0 max	...	1.5 max	1.5–4.0	...	...
Silicon, max	1.0	1.0	1.0 max	0.8 max	0.3	0.1
Phosphorus, max	0.04	0.03	0.04 max	0.04 max	0.020	0.020
Sulfur, max	0.03	0.03	0.03 max	0.02 max	0.010	0.010
Columbium + tantalum	1.75–2.50	...	0.50 max	0.30–1.50	...	...
Titanium	...	0.7–1.5	...	...	...	...
Nitrogen	0.15-0.25	...	...	...	...	0.10-0.25
Aluminum						0.3

[A] See 13.1.1.

TABLE 2 Mechanical Property Requirements

Alloy	Specified Diameter, in. (mm)	Tensile Strength min, psi (MPa)	Yield Strength (0.2 % Offset), min, psi (MPa)	Elongation in 2 in. or 50.8 mm or 4*D*[A] min
N06007	5/16 to 3/4 (7.94 to 19.05), incl	90 000 (621)	35 000 (241)	35
	Over 3/4 to 3 1/2 (19.05 to 88.9), incl	85 000 (586)	30 000 (207)	30
N06975	5/16 to 3 1/2 (7.94 to 88.9), incl	85 000 (586)	32 000 (221)	40
N06985	5/16 to 3/4 (7.9 to 19.05), incl	90 000 (621)	35 000 (241)	45
	Over 3/4 to 3 1/2 (19.05 to 88.9), incl	85 000 (586)	30 000 (207)	35
N06030	...	85 000 (586)	35 000 (241)	30
N08031	All sizes	94 000 (648)	40 000 (276)	40
N08034	All sizes	94 000 (650)	40 000 (280)	40

[A] *D* refers to the diameter of the tension specimen.

TABLE 3 Permissible Variations in Diameter and Out-of-Roundness of Rods

Specified Diameter, in. (mm)	Permissible Variations, in. (mm)		
	Diameter		Out-of-Roundness, max
	+	–	
Hot-Finished, Annealed, and Descaled Rods			
5/16 to 7/16 (7.94 to 11.11), incl	0.012 (0.305)	0.012 (0.305)	0.018 (0.457)
Over 7/16 to 5/8 (11.11 to 15.87), incl	0.014 (0.355)	0.014 (0.355)	0.020 (0.508)
Over 5/8 to 3/4 (15.87 to 19.05), excl	0.016 (0.406)	0.016 (0.406)	0.024 (0.610)
Hot-Finished, Annealed, and Ground or Turned Rods			
3/4 to 3 1/2 (19.05 to 88.9), incl	0.010 (0.254)	0	0.008 (0.203)

5.2 *Product (Check) Analysis*—If a product (check) analysis is made by the purchaser, the material shall conform to the requirements specified in Table 1 subject to the permissible tolerances in Specification B880.

6. Mechanical and Other Requirements

6.1 The material shall conform to the requirements of Table 2.

7. Straightness

7.1 The maximum curvature (depth of cord) shall not exceed 0.050 in. multiplied by the length in feet (0.04 mm multiplied by the length in centimetres).

8. Permissible Variations in Dimensions

8.1 *Diameter*—The permissible variations from the specified diameter and out-of-roundness shall be as prescribed in Table 3.

TABLE 4 Permissible Variations in Length of Rods

Random mill lengths	2 ft to 12 ft (61 cm to 366 cm) long with not more than 25 weight % under 4 ft (122 cm).
Multiple lengths	Furnished in multiples of a specified unit length, within the length limits indicated above. For each multiple, an allowance of 1/4 in. (6.35 mm) will be made for cutting, unless otherwise specified. At the manufacturer's option, individual specified unit lengths may be furnished.
Nominal lengths	Specified nominal lengths having a range of not less than 2 ft (61 cm) with no short lengths allowed.
Cut lengths	A specified length to which all rods will be cut with a permissible variation of + 1/8 in. (3.17 mm), – 0.